

BDCP Chapter 5: Effects Analysis  
Appendix D: Toxins**Issues Statement regarding Effects Analysis for toxins**

[Preamble: This document represents the highest level of organization of comments developed upon review of the Draft Toxins Appendix for Chapter 5 of the Bay-Delta Conservation Plan. The FWS has provided supporting documents to ICF (BDCP consultant) in the form of a *summary narrative* of general staff comments, and a table of specific staff-generated *editorial remarks* under separate cover.]

**Many of the issues related to toxins discussed in this appendix are inherent to the Delta and not directly created by the proposed Plan.** However, it is possible that where toxic problems exist in the Delta proposed water operations and habitat restoration may alter the fate, transport of, or the accumulation of these toxins in the estuary food web and in covered species. The Effects Analysis must identify any such areas of concern and describe how foreseeable changes to toxins would likely affect covered species.

The appendix describes conceptual modeling and “results” while including very little description of method. In instances where results are presented the effects of the proposed Plan are intermixed with asserted outcomes of other contaminant-related regulatory efforts. The appendix makes repeated references to modeling performed as part of the EIS/EIR – we assume this refers to what will be eventually reviewed by our sister regulatory Agency, the US EPA, which bears Clean Water Act review responsibility.

- ❖ *The conclusions of those models are presented but with no details on methods or assumptions. The discussion directly follows the EIS/EIR analysis results with the statement that the quantification of the effects of water operations is “not possible given the lack of current information current concentrations and distributions.” What models were investigated and found not useful and why? Are quantitative models available or not? If they are available but not used, reason should be given as to why they were unusable for the EA but appropriate for the EIS/EIR.*

**There is, overall, a lack of useful detail. The toxins analysis suffers from a lack of graphical conceptual models for individual constituents. Each constituent behaves differently in biogeochemical cycling.** The lack of consideration of the behavior of the constituent in the environment is evident in the overly-simplified nature of the proposed analyses. For example, the environmental fate discussions do not adequately analyze how water project operations or habitat restoration move or modify toxic constituents in the Delta. How will the proposed Plan affect the speciation of toxic constituents?

- ❖ *Because loading and concentrations of contaminants can vary with hydrology, analysis should take water year type into consideration. Full descriptions of hydrodynamics, variation in constituent behavior with water years, wetland management and effect on increased residence times on chemical constituents are needed.*

**The discussion of pollutant sources is incomplete and too general.** Please revise to include a more thorough description of both point and non-point sources for toxic constituents and the contributions from each watershed. From where is each chemical constituent coming? Are inputs still being made and are they increasing or decreasing? Please include source loadings to proposed wetland restoration areas and the Delta. For example, how does contribution of pyrethroids differ from non-point runoff from agriculture and urban stormwater versus the input of Sacramento Regional Wastewater Treatment Plant?

- ❖ *Quantitative modeling for each of the relevant constituents is a large undertaking. Believability of the appendix improves when modeling options are discussed and the rationale for the elimination of quantitative models is presented. What models are available (especially for mercury and selenium)? Why are some determined to be inappropriate or impractical? Conceptual models are a reasonable alternative in circumstances where quantitative models are not available, but these may not be useful for quantitative comparisons between alternatives. What is needed for a conceptual model to be adequate is a detailed narrative of each constituent's behavior within the Delta for each water year type and how the proposed Plan will change that behavior and its interaction with covered species, their prey and their habitat.*

**There are no credible estimates of effects of the proposed Plan on covered fishes in the appendix.** It will be necessary to provide specific and relative comparisons of current and proposed Plan environmental conditions. It must also be considered that current and future monitoring and modeling of toxin fate and transport within the Delta will not soon be sufficiently developed or implemented to be able to show meaningful differences between proposed alternatives, or to detect such differences upon implementation.

- ❖ *For example, in D.6.2 levels of copper in through much of the Delta are “not extremely high.” Copper disrupts salmonid olfactory function at the microgram per liter level. How does this relate to the “not extremely high” values at present and in the future within the proposed Plan?*

## Toxin-specific information and questions

### Mercury

**The DRERIP Mercury Conceptual Model is available at:**

[http://science.calwater.ca.gov/pdf/drerip/DRERIP\\_mercury\\_conceptual\\_model\\_final\\_012408.pdf](http://science.calwater.ca.gov/pdf/drerip/DRERIP_mercury_conceptual_model_final_012408.pdf) This model was developed by several of the key researchers of mercury dynamics in the San Francisco Estuary watershed (Alpers et al. 2008). The Service provides the following to fill out a conceptual background for BDCP's Effects Analysis:

**For the most part, *managed* Plan flows probably cause only undetectable variation in mercury loading.** As the Toxins Appendix notes, most of the ongoing mercury load (> 50%) is coming from Cache Creek, which is not a Project stream. The rest of the mercury that can become bioavailable is either already in the Delta sediments and methylated in existing wetlands (not a Project effect) or is mobilized and transported into the Delta from tributary streams, particularly during high flow events.

**A large potential Plan effect that might increase MeHg accumulation in target or non-target species is converting farmland to wetlands and enhancing some existing wetlands and floodplains.** The places this may have the biggest influence on MeHg accumulation are the Cache Creek and Cosumnes River confluence regions where mercury monitoring of fishes has shown elevated body burdens (Slotton et al. 2002; Davis et al. 2008; Henery et al. 2010). The BDCP is also proposing more frequent Yolo Bypass inundation, which might generate more MeHg production (Alpers et al. 2008), but the plan proposes to flood with Sacramento River water which may decrease MeHg accumulation rates for fishes using the bypass relative to what they would accumulate when only west-side streams are flooding the bypass (Henery et al. 2010). That said, MeHg generation can already be moderate to high in managed wetland, rice field, and other irrigated ag soils in the region (Table 2 of Alpers et al. 2008), so it is not a certainty that land use changes proposed by BDCP will increase the MeHg burden in the ecosystem over baseline levels.

**The accumulation of MeHg by fishes does not always spatially match the ambient production of this toxin** (Slotton et al. 2002). MeHg body burden will probably reflect fish feeding history (Matta et al. 2001; Hammerschmidt and Sandheinrich 2005; Deng et al. 2008). Planktivores (smelts) generally accumulate less than benthivores (sturgeon and splittail). The same is true for selenium accumulation. The effects of dietary MeHg have been studied on multiple generations of mummichogs (Matta et al. 2001). The 0.01 ug/g order of magnitude body burden was not found to affect survival, egg production, fertilization success, fish weight, or the performance of the F<sub>1</sub> and F<sub>2</sub> offspring. Fish diets containing ca.

10 ug/g MeHg order of magnitude in the prey were found to cause readily observable problems for both mummichogs (Matta et al. 2001) and splittail larvae (Deng et al. 2008).

**The draft appendix is using an inappropriate conceptual model regarding egg exposure to MeHg.** The primary source of exposure is maternal transfer – not absorption through the egg membrane. The major source of MeHg to fish *eggs* is maternal transfer due to the food eaten by females *only during egg development* (Hammerschmidt and Sandheinrich 2005). This means that delta smelt foraging near Yolo Bypass or splittail foraging in Yolo Bypass and the Cosumnes River immediately prior to spawning are likely to accumulate comparatively high levels of MeHg in their eggs. The Mississippi silverside biosentinel results for the San Joaquin River (Slotton et al. 2002) also suggest that splittail moving up the SJR to spawn will also have comparatively high egg MeHg concentrations. These are all significant spawning locations for splittail and they use them to greatest degree and success during high flows when MeHg accumulation is highest. This is evidence that splittail production is limited to much greater extent by spawning habitat availability among years than MeHg toxicity. MeHg concentrations in Bay-Delta Mississippi silversides are highest in wet years; MeHg in Corbicula clams is elevated in the low-salinity zone and MeHg production is elevated in floodplains and wetlands (Slotton et al. 2002), habitats associated with native fish production (Meng et al. 1994; Sommer et al. 1997; Meng and Matern 2001; Feyrer et al. 2007; Hobbs et al. 2010).

**Under current conditions, since MeHg-associated mortality is not apparent in native low-salinity zone areas it is reasonable to conclude that MeHg exposure is not as important as the lack of appropriate high-quality habitat for native fishes.** This is not intended to dismiss the potential for mercury toxicity in the Valley. The reproduction of clapper rails is currently impaired by mercury contamination (Schwartzbach et al. 2006). However, this has not been demonstrated for Forster's terns, American avocets and black-necked stilts (Ackerman et al. 2007; 2008); the latter studies linked foraging site fidelity to mercury bioaccumulation. Thus, the best approach for BDCP is to incorporate site-specific monitoring of mercury bioaccumulation into its habitat restorations to determine if its actions generate detectable changes in potential toxicity to locally occurring wildlife.

## Ammonia

**Adequate data is available to model ammonia concentrations in the Sacramento River and downstream into Suisun Bay and to estimate the change due to lower Sacramento River flows due to the proposed North Delta Diversions.** Nitrogen uptake inhibition in phytoplankton in Suisun Bay has been documented at 4 micromoles/L (Dugdale et al. 2007). How will the project affect

concentrations of ammonia/ammonium with reduced Sacramento River dilutions with and without 2010 permit compliance? As described the proposed Plan will reduce dilution of WWTP effluent seaward of the intakes. Will the PP result in increased dilution of Stockton WWTP effluent? Will it increase residence times for WWTP nutrients in the Delta? Although Sacramento River ammonia concentrations do not exceed Ambient Water Quality Criterion, recent research suggests that phytoplankton uptake inhibition may be occurring downstream in Suisun Bay as a result of current effluent loads. Cannon et al. (2011) found a No Observable Effects Concentration (NOEC) of 5.0 mg/L  $\text{NH}_4\text{Cl}$  for delta smelt. Sublethal exposures of delta smelt altered gene transcription associated with cell membrane integrity, neurological and muscular function supporting theories that exposure to ammonia results in cell membrane destabilization which could affect membrane permeability and increase uptake resulting in synergy with other toxics. Toxicological evaluations of ammonia on two species of zooplankton important to delta smelt (*Pseudodiaptomus forbesi* and *Eurytemora affinis*) provide relevant toxicity thresholds (Werner et al 2010; Teh et al. 2011).

## Selenium

What will inundation of restoration marshes do to sequestered and incoming selenium? How will it change Se speciation and bioavailability? Speciation is particularly important in determining how much loading is required to result in dangerous concentration in the food web (Lemly and Smith 1987; Skorupa et al. 1996) since different species of selenium have differing bioavailability. Particulate forms of Se are particularly important in the role of bioaccumulation. How will the project affect them? We recommend the development of a graphical conceptual model to aid in answering these questions (see Figure 2, Lemly and Smith 1997). Will wetland restoration concentrate, make bioavailable and bioaccumulate more Se than the agricultural land it is replacing? What logic or analytic steps were used to make and defend this conclusion?

## Copper

### **Copper has been shown to impair salmonid olfaction at low concentrations.**

How will water operations and restoration affect the prevalence of each species of copper, bioavailability, etc.? The No Observable Effects Concentration for dissolved copper are 150  $\mu\text{g/L}$  for zooplankter *Eurytemora affinis* and 41.4 for  $\mu\text{g/L}$  delta smelt (Werner et al. 2010). Baldwin et al. suggests olfactory inhibition in juvenile Coho salmon between 1.0-20.9  $\mu\text{g/L}$ . Toxic thresholds for receptor pathways were found at 2.3-3.0  $\mu\text{g/L}$  over background. Additional research showed that predator avoidance behaviors of juvenile Coho were significantly impaired by copper at concentrations as low as 2  $\mu\text{g/L}$  (Sandahl et al. 2007). These experimental thresholds underline the importance of copper changes in the Delta and the necessity of qualitative modeling in wetland areas used by juvenile salmonids such

as Yolo Bypass. Please consider whether these concentrations are currently encountered in the Delta, and if the proposed Plan supposes any changes in the Delta copper concentrations as the result of changes to water operations during the planning horizon.

## **Pesticides**

**Conversion of land use from agriculture to wetland represents a potential reduction of pesticide use but not elimination of their use entirely** (e.g. mosquito control). It would be useful to see a quantitative estimate of this reduction and a description of how this effect will or will not cascade its way to covered species.

**Changes in water residence times and flushing flows in the Delta will affect pesticide toxicity in benthic sediments.** It would be useful to see a quantitative estimate of this change and a description of how this effect will or will not cascade its way to covered species.

## **Other Items of Note**

**Microcystis was not analyzed within this appendix.** This is a serious omission.

**Transfer of toxins to terrestrial environments and species were not analyzed within this appendix.** This is a serious omission.